



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/050,195	01/16/2002	Sang-Bom Kang	5649-912	6301

20792 7590 09/12/2003

MYERS BIGEL SIBLEY & SAJOVEC  
PO BOX 37428  
RALEIGH, NC 27627

EXAMINER

IM, JUNGHWA M

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 09/12/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

10/050,195

Applicant(s)

KANG ET AL.

Examiner

Junghwa M. Im

Art Unit

2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 27 May 2003.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-14 and 25-32 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-14 and 25-32 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

**Priority under 35 U.S.C. §§ 119 and 120**

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413) Paper No(s) \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## DETAILED ACTION

### *Claim Rejections - 35 USC § 102*

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

1. Claims 1 and 3-5 are rejected under 35 U.S.C. 102(b) as being anticipated by Chang et al. (US 5,672,542), hereafter Chang.

Regarding claim 1, Fig.1 of Chang shows a semiconductor device comprising a substrate 10, an insulating layer 20 disposed in a gap on the substrate, a liner layer 26 exhibiting compressive stress (col. 1, lines 32-33), a contact plug 28 exhibiting tensile stress (col. 1, lines 53-54) directly on the liner layer.

Regarding claim 3, the liner of Chang inherently possesses an amorphous structure since it is deposited by CVD.

Regarding claims 4 and 5, Fig. 1 of Chang shows an ohmic layer, Ti 24 between the liner and the insulating layer.

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

---

Art Unit: 2811

2. Claims 2 and 8-10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Taguwa et al. (US 6,107,190) hereafter Taguwa.

Regarding claim 2, Chang discloses substantially the entire claimed device including a TiN liner layer except a TiN contact plug. Taguwa discloses in Fig. 1D a TiN contact plug 84 exhibiting tensile stress (col. 2, lines 33-39). It would have been obvious to one of ordinary skill in the art at the time of the invention to form a TiN plug in the device of Chang with Taguwa's teaching since TiN is an art recognized equivalent of the plug material disclosed in Chang.

Regarding claims 8-10, Fig. 1D of Taguwa shows an aluminum layer 85(col.3, line 18).

3. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Moise et al. (US 6,534,809), hereafter Moise.

Regarding claims 11-13, Chang discloses substantially the entire claimed device except a capacitor structure on the contact plug. Fig.1 of Moise shows a capacitor 125 formed on a contact plug 114 and a capacitor with a lower electrode 124 made of Pt (col. 9, lines 27-39). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate Moise's teaching to Chang's device in order to fabricate a DRAM array with a charge storage capacitor.

4. Claim 14 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chang in view of Nagasaka et al. (US 6,300,683), hereafter Nagasaka.

Regarding claim 14, Chang discloses substantially the entire claimed device except a shape of the contact plug. However, Fig. 19D of Nagasaka shows a tapered contact plug 12. It would have been obvious to one of ordinary skill in the art at the time of the invention to form

---

Art Unit: 2811

a tapered contact plug of Chang with Nagasaka's teaching in order to form the plug without cracks. It is well known in the art that it is easier to fill contact/plug openings with tapered sidewalls.

5. Claims 25-29, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chang and Taguwa as applied to claim 2 above, and further in view of Moise.

Regarding claim 25, Fig.1 of Chang shows a contact plug in an insulating layer 20 having tensile stress (col. 1, lines 53-54), a TiN layer 26 surrounding the plug on contact and having compressive stress (col. 1, lines 32-33) and an ohmic layer 24 between the insulating layer and the TiN layer.

Chang discloses substantially the entire claimed device except a TiN plug. Taguwa teaches a TiN plug having a tensile stress (col. 2, lines 33-39) in lieu of W plug of Chang. It would have been obvious to one of ordinary skill in the art at the time of the invention to form a TiN plug in the device of Chang with Taguwa's teaching in order to reduced a production cost as taught in column 1, lines 57-61 of Taguwa.

The device with the teachings of Chang and Taguwa fails to show that a lower electrode of the capacitor structure contacting the upper surface of the TiN plug. Fig.1 of Moise shows a bottom electrode 124 of a capacitor 125 formed on a TiN contact plug 114 (col. 7, lines 43-50). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate Moise's teaching to the device of Chang and Taguwa in order to fabricate a DRAM array with a charge storage capacitor.

Regarding claim 26, Taguwa discloses a TiN plug formed by CVD (col.1, lines 57-61).

Regarding claim 27, Chang discloses a TiN layer formed by CVD (col. 3, lines 13-14).

---

In addition, CVD, ALD, CVD AND ALD are a process designation and would thus not carry patentable weight in this claim drawn to a product. See *In re Thorp*, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claim 28, Chang discloses a TiN layer has an amorphous crystal structure since it is deposited by PVC.

Regarding claim 29, Chang discloses a TiN liner formed by physical vapor deposition (col. 3, line 13). In addition, IPVD is a process designation and would thus not carry patentable weight in this claim drawn to a product. See *In re Thorp*, 227 USPQ 964 (Fed. Cir. 1985).

Regarding claim 31, Moise shows the upper conductive layer made of Pt (col.9, lines 30-33).

Regarding claim 32, Moise shows the upper conductive layer (51) comprising a lower electrode of a capacitor (col. 9, lines 27-29).

6. Claim 30 is rejected under 35 U.S.C. 103(a) as being unpatentable over Chang, Taguwa and Moise applied to claim 25 above, and further in view of Nagasaka.

Regarding claim 30, the device with combined teachings of Chang, Taguwa and Moise shows substantially entire claimed structure except a tapered contact plug. Fig. 19D of Nagasaka shows a tapered contact plug 12. It would have been obvious to one of ordinary skill in the art at the time of the invention to form a tapered contact plug of Chang with Nagasaka's teaching in order to form the plug without cracks. It is well known in the art that it is easier to fill contact/plug openings with tapered sidewalls.

---

7. Claims 6 and 7 are rejected under 35 U.S.C. 103(a) as being obvious over Chang.

Regarding claim 6, Chang does not explicitly disclose the thickness of the ohmic layer as claimed. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to have an intended range of the thickness for an ohmic layer as in pending claim, since it would have been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only in routine skill in the art. *In re Aller*, 105 USPQ 233.

Regarding claim 7, Fig. 1 of Chang does not explicitly show the thickness of the liner layer as claimed. However, it would have been obvious to one of ordinary skill in the art at the time of the invention to have an intended range of the thickness for an liner layer as in pending claim, since it would have been held that where the general conditions of a claim are disclosed in the prior art, discovering the optimum or workable ranges involves only in routine skill in the art. *In re Aller*, 105 USPQ 233.

### ***Response to Arguments***

Applicant's arguments with respect to pending have been considered but are moot in view of the new ground(s) of rejection.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

---

Art Unit: 2811

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (703) 305-3998. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on (703) 308-2772. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

jmi  
August 25, 2003

  
TOM THOMAS  
SUPERVISORY PATENT EXAMINER  
TECHNOLOGY CENTER 2800